Student Edition

California Education and the Environment Initiative

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Biology Standard B.8.b.

Biological Diversity: The World's Riches

California Education and the Environment Initiative
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California State Board of Education
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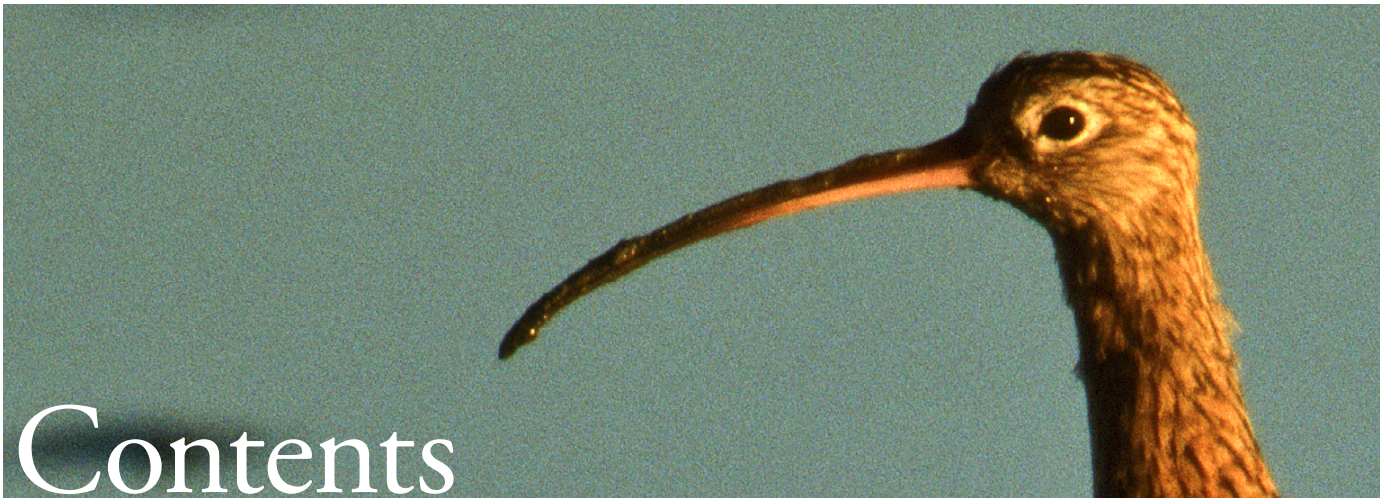

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Coastal Wetlands, Treasures of Diversity

Coastal wetlands act as nurseries for ocean fish and help cleanse polluted fresh water as it flows into the ocean. Such features in these transition zones between bodies of water and dry land make these ecosystems some of California's most ecologically significant.

Coastal wetlands include a number of natural communities that share the combination of aquatic, semiaquatic, and terrestrial habitats that result from periodic flooding by tidal waters, rainfall, or runoff.

Coastal wetlands support high levels of biological diversity (biodiversity), meaning they contain many different species in their many habitats. Wet soils and water-tolerant plants abound in wetlands, which are intermittently covered by shallow water. In the coastal zones of California, there are many different types of wetlands. The most common types are estuarine salt marshes and mudflats. An estuary is an area where a freshwater river meets the ocean. Salinity fluctuates in estuaries as ocean tides rise and fall, causing predictable cycles of flooding and flushing. In these areas, plants must be able to tolerate salty water to survive.

Other types of coastal wetlands in California include freshwater marshes, bogs, vernal pools, and riparian zones along rivers and streams.

Wetland Formation

Geologic and climatic processes created our diverse coastal zones. California is situated on the edge of a dynamic continental plate that has been pushed upward over millions of years by the expanding Pacific Plate. Geologists refer to the movement of these plates as continental drift. Ancient rivers flowing into the Pacific Ocean eroded the rising land mass, forming canyons and valleys. The geologic processes of "continental drift" and erosion defined the rivers and valleys that we know today. Climatic processes further define these regions. During extended periods of cold weather known as "ice

Elkhorn Slough, California

Long-billed curlew

ages," sea water evaporates and is deposited on land in glaciers, causing a decrease in global sea levels. Ice in glaciers reached its greatest volume 18,000 years ago during the most recent glacial period, with sea level more than 328 feet (100 meters) below its present level.

The rivers that had cut their way through the rising land to the ocean emptied their fresh water into the ocean. Earth has been slowly warming over the past 18,000 years, with glaciers melting and sea levels reaching their present depth approximately 7,000 years ago. Flooded coastal river valleys created bays, estuaries, and lagoons. Coastal wetlands formed at the fringes of these large water bodies. These areas are now exposed to fresh water from rivers and rain, as well as tidal influxes of ocean salt water.

California's Wetlands

California has 110 major coastal wetlands, each of which is isolated and biologically diverse. In northern California, most of the coastal wetlands are estuaries and salt marshes bordering river mouths. The San Francisco Bay estuary is the largest on the west coast of both North and South America. This estuary is also one of the most altered wetland areas in the United States. Historically, Southern California supported an extensive network of coastal wetlands at river mouths with salt marshes flanking the region's bays and lagoons. Today, these coastal wetlands fall within highly urbanized locations. The wetlands that remain there are small and isolated from other wetlands, but still play an important role in preserving biodiversity.

The Salt Marsh

The coastal salt marsh, a specific type of coastal wetland, is one of the most productive ecosystems in the world. Coastal salt marsh primary productivity—the rate at which energy accumulates in an ecosystem as a result of photosynthesis by plants—rivals that of tropical rainforests. A variety of animals can consume this energy accumulated in plants, forming a diverse and intricate food web. Marsh plants and phytoplankton that sequester energy from the Sun form the base of a salt marsh's food web. Abundant sunlight in shallow marsh water allows these organisms to photosynthesize at a high rate. Shrimp, clams, oysters, and some fish eat phytoplankton and zooplankton. Larger fish, birds, and wetland mammals in turn eat these animals.

When animals die, decomposers, such as bacteria and fungi, break them down and convert them into nutrient-rich detritus. Waste products from animals add more nutrients to the water and soil. Tides, freshwater flows, and the burrowing action of bottom-dwelling animals circulate the nutrients for use by new organisms. Flowing rivers also carry some nutrients to the ocean, while animals that feed in the marsh and then travel to upland habitats export still other nutrients to upland ecosystems.

There are many diverse habitats in a salt marsh ecosystem. Combined with high primary productivity, this habitat diversity gives rise to astonishing biological diversity. Hundreds of species are adapted to take advantage of different opportunities within this ecosystem. Birds, such as curlews and godwits, have long legs for wading and long beaks for probing for invertebrates in the mud. The rare light-footed clapper rail makes a platform nest of cordgrass in the lower reaches of the marsh, while the equally rare Belding's savannah sparrow nests in the pickleweed in the upper marsh. Migratory birds use salt marshes for resting and feeding stops during their long journey along a migratory route known as the Pacific Flyway. Marsh hawks fly low, hovering in search of rabbits and other small vertebrates that live in the vegetation along the marsh's fringe. Eelgrass beds provide nurseries for many species of juvenile fish, such as the California killifish, pipefish, bay goby, and striped bass. Upland species, such as the raccoon, fox, and coyote, follow the waterline, hunting and foraging.

Salt Grass

Adaptations

Many organisms have adaptations that allow them to cope with the marsh's constantly changing and often extreme environment characterized by high salt concentrations, periodic flooding and drying, and low oxygen levels in waterlogged soils. For example, saltgrass has adapted to excrete salt before it builds up to toxic levels. Many wetland plants contain air spaces in their roots and stems that allow oxygen to diffuse from the tops of plants to the roots. This adaptation allows them to survive in the anaerobic wetland soils. Fiddler crabs are active during low tides when water recedes from mudflats. Since they breathe air, these crabs hide in burrows when the tides rise. There, a pocket of air supplies them with oxygen.

Why They Matter

People rely on many ecosystem goods and ecosystem services provided by coastal wetlands. Marsh plants, such as eelgrass, decrease the speed of currents, absorb wave action, and capture sediments, slowing erosion and protecting shorelines. Coastal wetlands

can also store large quantities of water, helping to control flooding. Wetlands also improve water quality. Water flowing into a wetland often contains pollutants from a watershed's upper reaches. As currents slow, sediments settle out. Pollutants in those sediments sink into the wetland floor, where they are buried in layers. To varying degrees, wetland plants take up pollutants, while microorganisms in their tissue and roots break other pollutants down. By acting as natural "water filters," wetlands decrease the amount of pollution that drains into bays and oceans. Wetlands also support fisheries by providing critical habitat and nurseries for commercially important species.

Before the 1970s, many people viewed wetlands as "wasted land." Builders drained, filled, and developed these "swamplands" for housing or commercial development. Industrial pollutants contaminated many remaining wetlands, and road construction blocked critical tidal flow, degrading coastal ecosystems. Additional wetlands have been shrunk or eliminated by the dredging of port channels and filling of estuaries for boat facilities. Tide gates and flood control projects change the natural flow of salt water and fresh water.

Roads over Sweetwater Marsh, San Diego, California

Today, state and federal laws protect the remaining coastal wetlands in California, with further development tightly regulated. But coastal wetlands still suffer from the legacy of past development—all of the activities described above affect the health and functioning of these systems.

Since the 1850s, 97% of California's original coastal wetland acreage has disappeared. The remaining areas represent a critical part of California's biological diversity. As people seek to protect them, they also seek to protect the state's high levels of biological diversity and the goods and services these ecosystems provide. In turn, protectors of wetlands enhance quality of life for humans, today and in the future.

Great Basin Desert

The Great Basin Desert is the largest and northernmost desert in the United States. This arid region covers approximately 190,000 square miles centered in Nevada and touching parts of California, Utah, Idaho, and Oregon. This desert sits in the rainshadow of the Sierra Nevada mountain range of eastern California. Prevailing winds from the Pacific Ocean rise to go over the Sierra Nevada. The air cools and most of its moisture falls as rain on the western slopes of the range. By the time the air reaches the far side of the mountains, it is dry and absorbs moisture from its surroundings. This drying effect creates the Great Basin Desert.

This desert sits at a high altitude. The lowest basins in the Great Basin Desert are higher than 3,000 feet in elevation; some peaks reach 12,000 feet. Average elevations in the Great Basin range from 4,000 to 6,500 feet. Because of its northerly latitude and relatively high elevation, the Great Basin Desert is considered a "cold" desert, the only one in the United States. Temperatures are cooler than in "hot" deserts and in winter, there is usually snow. Precipitation averages 7 to 12 inches per year and is relatively evenly distributed throughout the year.

Vegetation is similar throughout this desert; variation in plant life is low compared to other deserts. Low-growing shrubs are the most common form of vegetation. Few cacti grow here. A single species of bush—often sagebrush—typically dominates the landscape for miles. Great Basin animals include the bighorn sheep, jackrabbit, pocket mouse, pronghorn antelope, sage thrasher, golden eagle, and the western diamondback rattlesnake.

Great Basin Desert, Nevada

Mojave Desert

The Mojave Desert is situated between the Great Basin Desert to the north and the Sonoran Desert to the south. It is 25,000 square miles, centered in southeastern California and reaching into Nevada, Arizona, and Utah.

While typical elevation in the Mojave varies from 3,000 to 6,000 feet, this desert has its extremes. Telescope Peak is located at 11,049 feet and Badwater—the lowest point in the United States—is located at 282 feet below sea level.

Both latitude and altitude affect the climate, which experiences variations in temperature and rainfall. The Mojave is relatively hot year-round, but there are four distinct seasons. During winter storms, temperatures can get lower than 20º F (-6.7º C), but may reach 80º F (26.7º C) between storms. It is often cloudy and windy in winter, and it occasionally snows. Spring rains are infrequent but widespread, with temperatures typically above 90º F (32.2º C). Summer brings extreme heat and thunderstorms. Temperatures reach 120º F (48.9º C) on valley floors. October is normally the driest month of the year; rain is infrequent in fall, and temperatures average 70º F (21.1º C) to 90º F (32.2º C). The Mojave generally receives less than 10 inches of rain each year.

The Mojave is geographically varied, made up of mountains and valleys. It is home to more than 2,000 species of plants, which are fairly evenly distributed throughout the region. Lowland shrubs, such as creosote and sagebrush, are common, as are a few species of cacti. One of the most characteristic plants of the Mojave Desert is the Joshua tree. In the Mojave, plants and animals must be adapted to a long dry season and relatively cold winters.

Mojave Desert, California

Sonoran Desert

The Sonoran Desert is an arid region in southwestern Arizona and southeastern California. The 120,000-square-mile desert also covers most of Baja California and the western half of the state of Sonora, Mexico.

The Sonoran Desert is the hottest and wettest desert in North America. It is also the country's southernmost desert and has the lowest average elevation. Storms come in from the Pacific during winter; summer sees a somewhat rainy monsoon season. With its two-season rainfall pattern, the Sonoran Desert is the wettest desert in the world. Some areas receive as much as 25 inches of rainfall annually. Summer temperatures average about 110° F (43.3° C) during the day and between 40–50° F (4–10° C) during the night. Winters are relatively warm.

Reliable sources of water in this habitat throughout the year allow for a wider variety of plants to grow in the Sonoran than other deserts. Winter storms give way to rich blankets of spring wildflowers. The Sonoran Desert is the only place in the world where the towering saguaro cactus grows wild. Many other species of cactus are found here, too. Desert streams here are sometimes lined with trees, including ash, walnut, cottonwood, and willow. An understory of woody shrubs occurs below the trees. The relatively wide variety of plant communities in this desert feed and house many animals, including many types of mammals, reptiles, and birds.

Sonoran Desert, Arizona

Kingfisher Background Information

There are 90 species of kingfishers in the world. The species are divided into three groups: tree, river, and water kingfishers. All are small- to medium-sized colorful birds with short necks, relatively large heads, and long, thick bills. They live in all regions of the world, except the polar regions and some ocean islands. They live in forested or open woodlands, often near water, and in aquatic habitats including seashores, mangrove swamps, lakes, rivers, and streams. One species lives in desert scrub. Most kingfisher species nest in horizontal tunnels in earthen banks. Some nest in tree cavities or other openings.

This lesson focuses on six New World species from the water kingfisher group. These kingfishers are fish-eaters. Although all six species have long, thick bills, the bills vary in shape according to the eating habits of each species. Different-sized bills enable the kingfishers to eat different-sized fish, thus reducing competition among kingfisher species (and between kingfishers and other species) in the same general habitat.

American Pygmy Kingfisher
Chloroceryle aenea

Size: 5 inches, 0.63 ounces; short tail and long bill

Range: Southern Mexico to northern Bolivia and southern Brazil

Habitat: This tiny kingfisher lives in dense forests and mangroves along small streams or rivers with heavily vegetated banks. It usually nests in horizontal tunnels in river banks.

Food: Small fish or tadpoles

Green Kingfisher
Chloroceryle americana

Size: 7–8 inches, 0.95 ounces; short tail and long bill

Range: Extreme southwestern United States to northern Chile and central Argentina

Habitat: This small kingfisher lives in forests or mangroves along small streams.

Food: Fish and aquatic insects

Green-and-rufous Kingfisher
Chloroceryle inda

Size: 8–9 inches, 2.11 ounces; short tail and long bill

Range: Nicaragua to northern Bolivia and central Brazil

Habitat: This small kingfisher lives near rivers and streams in dense lowland forests and mangroves.

Food: Fish

Amazon Kingfisher
Chloroceryle amazona

Size: 11–12 inches, 3.88 ounces; short tail and long bill

Range: Mexico to central Argentina

Habitat: This medium-sized kingfisher lives near rivers and streams.

Food: Fish

Belted Kingfisher
Megaceryle alcyon

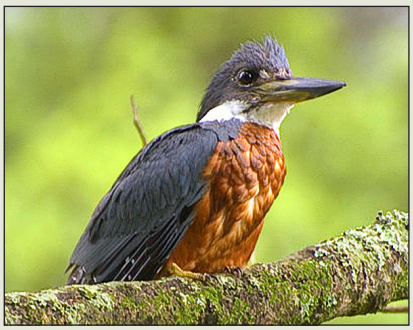
Size: 12–13 inches, 5–6 ounces; short tail and long bill

Range: North America to Panama

Habitat: This kingfisher lives near streams, lakes, bays, and coasts.

Food: Fish

Ringed Kingfisher
Megaceryle torquata



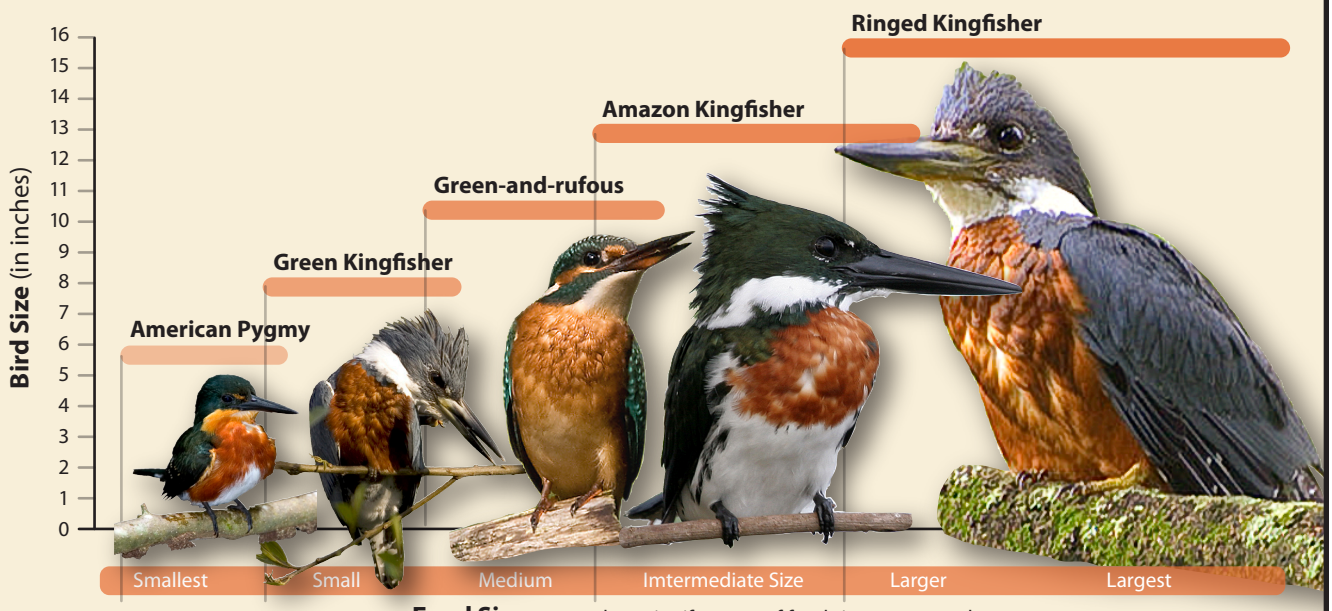
Size: 15–16 inches, 11.1 ounces; short tail and long bill

Range: Southern Texas and Mexico to Tierra del Fuego

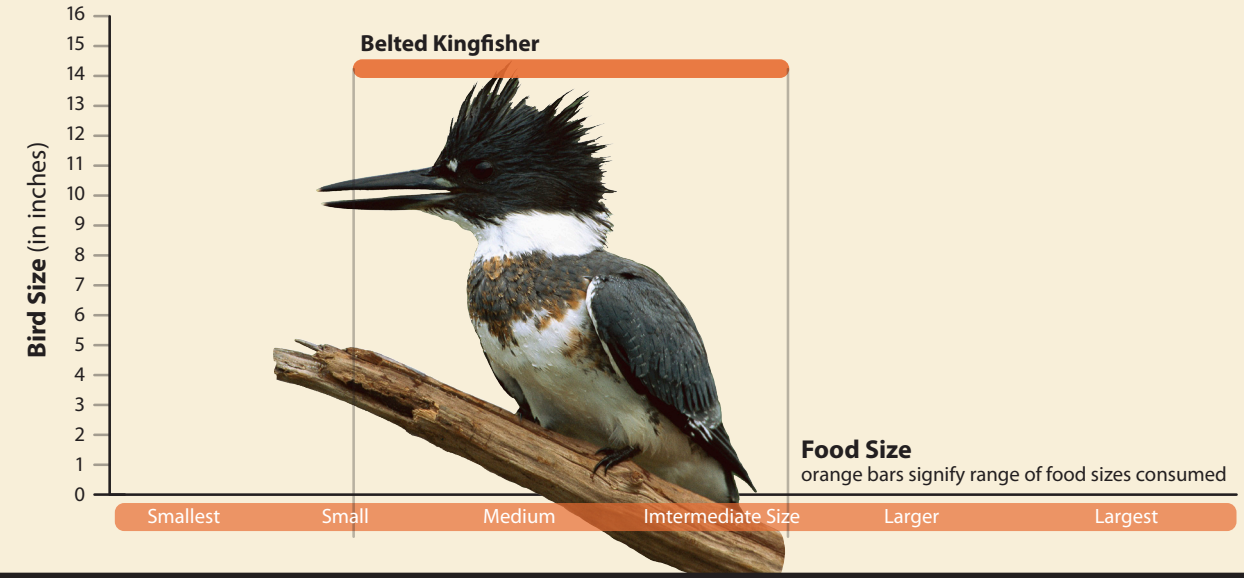
Habitat: This large kingfisher lives near rivers and streams.

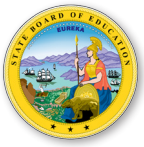
Food: Fish

Kingfishers of Panama



Belted Kingfisher





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